

## CLAIMS:

We claim:

1. A method of rearranging an initial hierarchical menu in a voice portal directory having a plurality of voice portlets arranged in one or more layers and including a set of non-terminal nodes and a set of terminal nodes, said method comprising the steps of:
  - creating a second hierarchical menu having the set of terminal node voice portlets arranged in a single layer;
  - restoring a portion of the initial hierarchical menu in the second hierarchical menu by replacing one or more groups of voice portlets in the single layer with one or more corresponding non-terminal nodes from the initial hierarchical menu until a resulting number of voice portlets in the single layer does not exceed a pre-determined limit;
  - restoring a portion of the initial hierarchical menu in the second hierarchical menu by replacing one or more groups of voice portlets in the single layer with one or more corresponding non-terminal nodes from the initial hierarchical menu until there are no duplicate voice portlets in the single layer;
2. The method of claim 1, further comprising:
  - measuring a frequency of use for each of the plurality of voice portlets;
  - ordering the plurality of voice portlets in a sequence within the single layer by order of descending frequency of use.

3. A method of rearranging a first hierarchical menu in a voice portal directory, the first hierarchical menu having one or more layers and a plurality of nodes, the plurality of nodes including one or more non-terminal nodes, each having one or more lower nodes, and a first number of terminal nodes, said method comprising the steps of:

generating a second hierarchical menu having only a first layer, the first layer having an initial set of nodes identical to the first number of terminal nodes;

reading a predetermined limit;

comparing the first number with the predetermined limit;

replacing, if the first number exceeds the predetermined limit, a first set of nodes in the first layer with a first replacement non-terminal node and connecting the first set of nodes as terminal nodes to the first replacement non-terminal node, the first replacement non-terminal node being the one of the non-terminal nodes in the first hierarchical menu having terminal nodes identical to the first set of nodes.

4. The method of claim 3, further comprising:

reading a frequency of use for each node in the first hierarchical menu; and

arranging the nodes in the first layer in order of descending frequency of use.

5. The method of claim 4, further comprising:

wherein the first replacement non-terminal node has the lowest frequency of use of all the non-terminal nodes in the first hierarchical menu.

6. The method of claim 4, further comprising:

computing an average frequency of use for each of non-terminal node in the first hierarchical menu, each average frequency of use being equal to the average of the frequency of use for all of the lower nodes connected to said each non-terminal node;

wherein the first replacement non-terminal node has the lowest average frequency of use of all the non-terminal nodes in the first hierarchical menu.

7. The method of claim 3, further comprising:

reading a number of nodes in the first layer;

replacing a sequence of one or more successive sets of nodes in the first layer with a sequence of corresponding replacement non-terminal nodes and connecting each of the successive sets of nodes, along with any of its lower nodes, to the replacement non-terminal node corresponding to each successive set until the number of nodes in the first layer does not exceed the predetermined limit, each of the corresponding replacement non-terminal nodes being selected from the non-terminal nodes in the first hierarchical menu having lower nodes identical to the one of the one or more successive set of nodes to which the corresponding replacement non-terminal node corresponds.

8. The method of claim 7, further comprising:

reading a frequency of use for each node in the first hierarchical menu; and  
arranging the nodes in the first layer in an order of descending frequency of use.

9. The method of claim 8,  
wherein the sequence of corresponding replacement non-terminal nodes is  
sequenced in order of ascending frequency of use.
10. The method of claim 8, further comprising:  
computing an average frequency of use for each of the non-terminal nodes in the  
first hierarchical menu, each average frequency of use being equal to the average of the  
frequency of use for all of the lower nodes connected to said each non-terminal node;  
wherein the sequence of corresponding replacement non-terminal nodes is  
sequenced in order of ascending average frequency of use.
11. A method of rearranging a first hierarchical menu in a voice portal directory, the  
first hierarchical menu having one or more layers and a plurality of nodes, the plurality  
of nodes including one or more non-terminal nodes, each having one or more lower  
nodes, and a first number of terminal nodes, said method comprising the steps of:  
generating a second hierarchical menu having only a first layer, the first layer  
having an initial set of nodes identical to the first number of terminal nodes;  
comparing each of the initial set of nodes with all other nodes in the initial set;  
replacing, if two or more of the nodes in the initial set are identical, a first set of  
nodes in the first layer with a first replacement non-terminal node and connecting the  
first set of nodes as terminal nodes to the first replacement non-terminal node, the first  
replacement non-terminal node being the one of the non-terminal nodes in the first  
hierarchical menu having terminal nodes identical to the first set of nodes.

12. The method of claim 11, further comprising:  
reading a frequency of use for each node in the first hierarchical menu; and  
arranging the nodes in the first layer in order of descending frequency of use;
13. The method of claim 12,  
wherein the first replacement non-terminal node has the lowest frequency of use  
of all the non-terminal nodes in the first hierarchical menu.
14. The method of claim 12, further comprising:  
computing an average frequency of use for each of the non-terminal nodes in the  
first hierarchical menu, each average frequency of use being equal to the average of the  
frequency of use for all of the lower nodes connected to said each non-terminal node;  
wherein the first replacement non-terminal node has the lowest average  
frequency of all the non-terminal nodes in the first hierarchical menu.

15. The method of claim 11, further comprising:

comparing each of the nodes in the first layer with all other nodes in the first layer to identify any duplicate nodes; and

replacing a sequence of one or more successive sets of nodes in the first layer with a sequence of corresponding replacement non-terminal nodes and connecting each of the successive sets of nodes, along with any of its lower nodes, to the replacement non-terminal node corresponding to each successive set until the first layer does not include any duplicate nodes, each of the corresponding replacement non-terminal nodes being selected from the non-terminal nodes in the first hierarchical menu having lower nodes identical to the one of the one or more successive set of nodes to which the corresponding replacement non-terminal node corresponds.

16. The method of claim 15, further comprising:

reading a frequency of use for each node in the first hierarchical menu; and  
arranging the nodes in the first layer in order of descending frequency of use.

17. The method of claim 16,

wherein the sequence of corresponding replacement non-terminal nodes is sequenced in order of ascending frequency of use.

18. The method of claim 16, further comprising:

computing an average frequency of use for each of the non-terminal nodes in the first hierarchical menu, each average frequency of use being equal to the average of the frequency of use for all of the lower nodes connected to the non-terminal node for which an average frequency of use is computed;

wherein the sequence of corresponding replacement non-terminal nodes is sequenced in order of ascending average frequency of use.

19. A machine readable storage having stored thereon a computer program for rearranging a first hierarchical menu in a voice portal directory, the first hierarchical menu having one or more layers and a plurality of nodes, the plurality of nodes including one or more non-terminal nodes, each having one or more lower nodes, and a first number of terminal nodes, said computer program comprising a routine set of instructions for causing the machine to perform the steps of:

generating a second hierarchical menu having only a first layer, the first layer having an initial set of nodes identical to the first number of terminal nodes;

reading a predetermined limit;

comparing the first number with the predetermined limit;

replacing, if the first number exceeds the predetermined limit, a first set of nodes in the first layer with a first replacement non-terminal node and connecting the first set of nodes as terminal nodes to the first replacement non-terminal node, the first replacement non-terminal node being the one of the non-terminal nodes in the first hierarchical menu having terminal nodes identical to the first set of nodes.

20. The machine readable storage of claim 19, further causing said machine to perform the steps of:

reading a number of nodes in the first layer;

replacing a sequence of one or more successive sets of nodes in the first layer with a sequence of corresponding replacement non-terminal nodes and connecting each of the successive sets of nodes, along with any of its lower nodes, to the replacement non-terminal node corresponding to each successive set until the number of nodes in the first layer does not exceed the predetermined limit, each of the corresponding replacement non-terminal nodes being selected from the non-terminal nodes in the first hierarchical menu having lower nodes identical to the one of the one or more successive set of nodes to which the corresponding replacement non-terminal node corresponds.

21. The method of claim 20, further causing said machine to perform the steps of:

reading a frequency of use for each node in the first hierarchical menu; and

arranging the nodes in the first layer in an order of descending frequency of use;

22. The method of claim 21,

wherein the sequence of corresponding replacement non-terminal nodes is sequenced in order of ascending frequency of use.



23. The method of claim 21, further causing said machine to perform the steps of:

computing an average frequency of use for each of the non-terminal nodes in the first hierarchical menu, each average frequency of use being equal to the average of the frequency of use for all of the lower nodes connected to said each non-terminal node;

wherein the sequence of corresponding replacement non-terminal nodes is sequenced in order of ascending average frequency of use.

24. A machine readable storage having stored thereon a computer program for rearranging a first hierarchical menu in a voice portal directory, the first hierarchical menu having one or more layers and a plurality of nodes, the plurality of nodes including one or more non-terminal nodes, each having one or more lower nodes, and a first number of terminal nodes, said computer program comprising a routine set of instructions for causing the machine to perform the steps of:

generating a second hierarchical menu having only a first layer, the first layer having an initial set of nodes identical to the first number of terminal nodes;

comparing the each of the initial set of nodes with all other nodes in the initial set;

replacing, if two or more of the nodes in the initial set are identical, a first set of nodes in the first layer with a first replacement non-terminal node and connecting the first set of nodes as terminal nodes to the first replacement non-terminal node, the first replacement non-terminal node being the one of the non-terminal nodes in the first hierarchical menu having terminal nodes identical to the first set of nodes.

25. The method of claim 24, further causing said machine to perform the steps of:
- comparing each of the nodes in the first layer with all other nodes in the first layer to identify any duplicate nodes; and
- replacing a sequence of one or more successive sets of nodes in the first layer with a sequence of corresponding replacement non-terminal nodes and connecting each of the successive sets of nodes, along with any of its lower nodes, to the replacement non-terminal node corresponding to each successive set until the first layer does not include any duplicate nodes, each of the corresponding replacement non-terminal nodes being selected from the non-terminal nodes in the first hierarchical menu having lower nodes identical to the one of the one or more successive set of nodes to which the corresponding replacement non-terminal node corresponds.
26. The method of claim 25, further causing said machine to perform the steps of:
- reading a frequency of use for each node in the first hierarchical menu; and
- arranging the nodes in the first layer in order of descending frequency of use.
27. The method of claim 26,
- wherein the sequence of corresponding replacement non-terminal nodes is sequenced in order of ascending frequency of use.

28. The method of claim 26, further comprising:

computing an average frequency of use for each of the non-terminal nodes in the first hierarchical menu, each average frequency of use being equal to the average of the frequency of use for all of the lower nodes connected to the non-terminal node for which an average frequency of use is computed;

wherein the sequence of corresponding replacement non-terminal nodes is sequenced in order of ascending average frequency of use.

29. A system for rearranging a first hierarchical menu in a voice portal, the first hierarchical menu having one or more layers and a plurality of nodes, the plurality of nodes including one or more non-terminal nodes, each having one or more lower nodes, and a first number of terminal nodes, the system comprising:

a voice aggregator configured for coupling to the voice portal to rearrange the first hierarchical menu, the voice aggregator being programmed to generate a second hierarchical menu having only a first layer, the first layer having an initial set of nodes identical to the first number of terminal nodes, and also programmed to read a predetermined limit and compare the first number with the predetermined limit, and also programmed to replace, if the first number exceeds the predetermined limit, a first set of nodes in the first layer with a first replacement non-terminal node and connect the first set of nodes as terminal nodes to the first replacement non-terminal node, the first replacement non-terminal node being the one of the non-terminal nodes in the first hierarchical menu having terminal nodes identical to the first set of nodes.

30. The system of claim 29,

wherein the voice aggregator is further programmed to read a frequency of use for each node in the first hierarchical menu, and is also programmed to arrange the nodes in the first layer in order of descending frequency of use.

31. The system of claim 29,

wherein the voice aggregator is further programmed to read a number of nodes in the first layer, and is further programmed to replace a sequence of one or more successive sets of nodes in the first layer with a sequence of corresponding replacement non-terminal nodes and connecting each of the successive sets of nodes, along with any of its lower nodes, to the replacement non-terminal node corresponding to each successive set until the number of nodes in the first layer does not exceed the predetermined limit, each of the corresponding replacement non-terminal nodes being selected from the non-terminal nodes in the first hierarchical menu having lower nodes identical to the one of the one or more successive set of nodes to which the corresponding replacement non-terminal node corresponds.

32. The system of claim 31,

wherein the voice aggregator is further programmed to read a frequency of use for each node in the first hierarchical menu, and is further programmed to arrange the nodes in the first layer in an order of descending frequency of use.

33. A system for rearranging a first hierarchical menu in a voice portal, the first hierarchical menu having one or more layers and a plurality of nodes, the plurality of nodes including one or more non-terminal nodes, each having one or more lower nodes, and a first number of terminal nodes, the system comprising:

a voice aggregator configured for coupling to the voice portal to rearrange the first hierarchical menu, the voice aggregator being programmed to generate a second hierarchical menu having only a first layer, the first layer having an initial set of nodes identical to the first number of terminal nodes, and also programmed to compare each of the initial set of nodes with all other nodes in the initial set, and also programmed to replace, if two or more of the nodes in the initial set are identical, a first set of nodes in the first layer with a first replacement non-terminal node and to connect the first set of nodes as terminal nodes to the first replacement non-terminal node, the first replacement non-terminal node being the one of the non-terminal nodes in the first hierarchical menu having terminal nodes identical to the first set of nodes.

34. The system of claim 33,

wherein the voice aggregator is further programmed to read a frequency of use for each node in the first hierarchical menu, and is also programmed to arrange the nodes in the first layer in order of descending frequency of use.

35. The system of claim 33,

wherein the voice aggregator is further programmed to compare each of the nodes in the first layer with all other nodes in the first layer to identify any duplicate nodes, and is further programmed to replace a sequence of one or more successive sets of nodes in the first layer with a sequence of corresponding replacement non-terminal nodes and connect each of the successive sets of nodes, along with any of its lower nodes, to the replacement non-terminal node corresponding to each successive set until the first layer does not include any duplicate nodes, each of the corresponding replacement non-terminal nodes being selected from the non-terminal nodes in the first hierarchical menu having lower nodes identical to the one of the one or more successive set of nodes to which the corresponding replacement non-terminal node corresponds.

36. The system of claim 35,

wherein the voice aggregator is further programmed to read a frequency of use for each node in the first hierarchical menu, and is also programmed to arrange the nodes in the first layer in order of descending frequency of use.